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sides $\alpha=0$, $\beta=0$, $\gamma=0$, $\delta=0$, and the *lengths* of the corresponding sides by a , b , c , and d . Let radius of circle be r . Then the equation of the line joining the middle points of the diagonals is $a\alpha-b\beta+c\gamma-d\delta=0 \dots (1)$ (Cf. Salmon's *Conics*, page 54, Ex. 5).

Putting $\alpha=\beta=\gamma=\delta=r$ we obtain $r(a-b+c-d)=0$, which is satisfied since $a+c=b+d$.

137. Proposed by J. W. YOUNG, Oliver Graduate Scholar in Mathematics, Cornell University, Ithaca, N. Y.

A right cone has its vertex in a horizontal plane, its axis being perpendicular to the plane. A string has one extremity attached to a point on the cone. The other extremity, P , of the string is kept in the plane, and the string is then wound around the cone, without being allowed to slip. Show that the spiral generated by P cuts all straight lines through the vertex at the same angle.

Solution by the PROPOSER.

Let P , P' be two points on the spiral; Q , Q' the corresponding points in the path of the string around the cone; N , N' the points where the perpendiculars from Q , Q' to the plane through the vertex O of the cone, cut the plane.

The right-angled triangles QNO , $Q'N'O$ have the angles QON and $Q'ON'$ equal; hence they are similar.

$$\therefore \frac{QN}{ON} = \frac{Q'N'}{ON'} \dots (1).$$

Again, since the string must not slip, it makes a constant angle with the plane.

$\therefore \triangle QNP$ is similar to $\triangle Q'N'P'$.

$$\therefore \frac{PN}{QN} = \frac{P'N'}{Q'N'} \dots (2).$$

From (1) and (2),

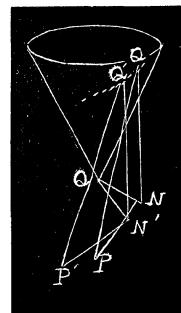
$$\therefore \frac{PN}{ON} = \frac{P'N'}{ON'} \dots (3).$$

But the triangles ONP and $ON'P'$ are right-angled at N and N' (PN , $P'N'$ being the projections to tangents to the circular cone). From (3),

$\therefore \triangle ONP$ is similar to $\triangle ON'P'$.

$$\therefore \angle OPN = \angle OP'N'.$$

Observing that PN and $P'N'$ are normals to the spiral, the last equation states that the normals make a constant angle with rays through O . Q. E. D.



AVERAGE AND PROBABILITY.

90. Proposed by WALTER H. DRANE, Graduate Student, Harvard University, Cambridge, Mass.

During a heavy rain storm a circular pond is formed in a circular field. If a man undertakes to cross the field in the dark, what is the chance that he will walk into the pond? [From *Byerly's Integral Calculus*.]

I. Solution by B. F. FINKEL, A. M., M. Sc., Professor of Mathematics and Physics, Drury College, Springfield, Mo.

Let O be the center of the circular field, and R its radius; C the center of